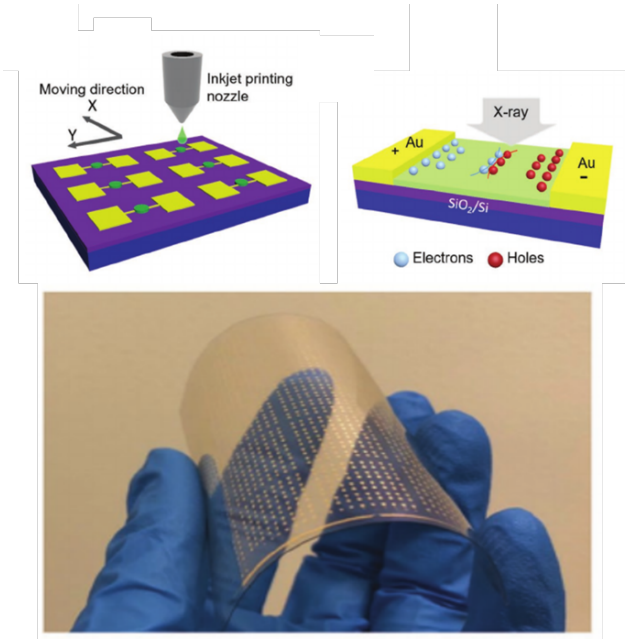
Flexible, Printable X-ray Detectors

Low-cost X-ray detectors featuring high sensitivity, durability and physical flexibility are required in fields ranging from medical imaging to defence. In this study, a new material for X-ray detection was coupled with inkjet printing to produce a series of prototype X-ray detectors. Using the Soft X-ray Beamline at the Australian Synchrotron, it was demonstrated that the new material offered class leading X-ray detection, offering great promise for future commercial X-ray detector development.



Schematic of the inkjet printing method and detection of x-rays (top), for a flexible array of X-ray detectors based on novel $CsPbBr_3$ quantum dots

Research & Outcomes

Researchers from Monash University's Department of Materials Science and Engineering recently synthesised a new type of X-ray detector based on quantum dots of $CsPbBr_3$, a class of material known as "perovskites" that are currently seeing early application in next generation solar cells.

The key breakthrough from the research group was the synthesis of $CsPbBr_3$ quantum dots from a low temperature liquid solution that could be printed onto a supporting material using a commercial inkjet printer. Both rigid (silicon) and flexible (polymer) substrate designs featuring printed arrays of X-ray detectors were fabricated and bought to the Australian Synchrotron for analysis.

At the Soft X-ray beamline, the researchers were able to investigate the response of the detectors when exposed to X-rays. Compared to a "typical" X-ray source, the beamline offers a wide range of X-ray energies to choose from, and the ability to control the X-ray brightness. Additional measurements probed the transient (time dependant) behaviour of the devices when the X-rays were turned off and on, to gain an understanding of how quickly the devices respond to an incident X-ray beam and the stability of the performance with repeated cycling.

The results showed that the X-ray detection performance of the $CsPbBr_3$ quantum dot-based were comparable with other perovskite-based X-ray detecting materials, but with the added benefit of physical flexibility. Moreover, they displayed over 70 times more sensitivity than devices based on existing semiconductor architectures using amorphous selenium.

Benefits & Impact

Compared with semiconductor fabrication technologies, solution (liquid) based synthesis of X-ray detector materials at low temperature is both cost effective and highly scalable. Coupled with inkjet printing onto flexible substrates, this research aims to realise new applications of X-ray detection in health, research, defence and more. The Australian Synchrotron was able to play a key role, providing a world leading X-ray source for characterisation of the devices

Reference: J. Liu et. al *Adv. Mater*. **2019**, 31, 1901644